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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/685,751

10/14/2003

Yong Liu

NTI-023-1D

6170

29477

7590

04/01/2004

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EXAMINER

ROSASCO, STEPHEN D

ART UNIT

PAPER NUMBER

1756

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/685,751

Applicant(s)

LIU ET AL.

Examiner

Stephen Rosasco

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1756

cb

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 10/14/03.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

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Detailed Action

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ferguson et al. (5,932,377).

The claimed invention is directed to a lithographic mask that provides phase shifting for features on a binary mask, the lithographic mask comprising: a plurality of first phase-shifting regions; and a plurality of second phase-shifting regions, wherein each first phase-shifting region has a corresponding second phase-shifting region, wherein a phase difference between the first and second phase-shifting regions is approximately 180 degrees, wherein each second phase-shifting region has a size based on a size of its corresponding first phase-shifting region.

Ferguson et al. teach a two-step method for eliminating transmission errors in alternating phase-shifting masks. Initially, the design data is selectively biased to provide a coarse reduction in the inherent transmission error between features of different phase, size, shape, and/or location. During fabrication of the mask with the modified data, residual transmission errors are then eliminated via the positioning of the

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edges of the etched-quartz trenches, which define the phase of a given feature to a set location beneath the opaque chrome film.

(col. 6, line 50 to col. 7, line 15) Referring to FIG. 7, transmission error between two adjacent features of opposite phase is quantified in the plot shown in FIG. 7 as a function of the coarse tuning via biasing of the design data (curve-to-curve variation) and fine tuning with the etch-back process (change in transmission error along one curve). A transmission error of 0% is the ideal value at which the two features are completely balanced. In FIG. 7, data point 100 represents the transmission error (approximately 28%) when no coarse or fine adjustments are applied. A displacement along the y-axis (etch back depth=0 nm) from data point 100 represents a change in transmission error from the coarse bias adjustment. For the design grid size of 25 nm used in this example, the effect of a coarse adjustment of one grid unit is to reduce the transmission error to 10% (i.e., at data point 110). For a two-grid step bias of 50 nm, the transmission error is over-corrected at data point 120. Thus, biasing the design data by a single grid step of 25 nm to point 110 provides the appropriate coarse adjustment to the transmission error. Three data points 111, 112, and 113 (in FIG. 7) show the effect of varying the etch back depth in order to remove the residual transmission error after completing the coarse adjustment.

The teachings of Ferguson et al. differ from those of the applicant in that the applicant teaches that each second phase-shifting region has a size based on a size of its corresponding first phase-shifting region. However, Ferguson et al. does teach that initially, the design data is selectively biased to provide a coarse reduction in the

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inherent transmission error between features of different phase, size, shape, and/or location.

Therefore, it would have been obvious to one having ordinary skill in the art to take the teachings of Ferguson et al. and adjust the size of one phase shifting region based on the size of the other phase shifting region in order to make the claimed invention because it is well known in the phase shifting art that the size and spacing of the shifters in a mask must be such that these phase shift regions do not produce phase conflicts.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen Rosasco whose telephone number is 571-272-1389. The examiner can normally be reached on M-F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff, can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

For general information call (571-272-1700).



S. Rosasco
Primary Examiner
Art Unit 1756

S. Rosasco
3/25/04